Space Weather Technical Forecast

Issued on Thursday 17 October 2024 at 13:03 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Ongoing chance of M-flares. Chance of G1 Minor Geomagnetic Storms days 1-2 (17-18 Oct).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with four M-flares observed through the period, with a peak flare of M3.7 at 16/0323 UTC from AR3852.

There are currently seven active regions on the visible disc, with an as yet unnumbered region forming in the southeast. AR3852 and AR3854 in the southwest quadrant form a coupled pair of sunspots and are the most prominent spot groups on the disc, being responsible for the majority of flare activity. AR3854 has seen little change recently, but the trailing region on AR3852 has now faded simplifying this to a unipolar region. AR3856 in the northwest near centre disk, has seen the most notable change in recent hours, continuing to increase in both size and complexity with an increasingly complex magnetic structure. The remaining regions appear magnetically simpler, and generally stable.

No Earth-directed CMEs have been observed in available imagery, although we await further imagery and analysis.

Solar Wind / Geomagnetic Activity: Solar wind speeds were slightly elevated on a slowly declining trend, reaching around 410km/s by the end of the period. Density at below average levels. The Interplanetary Magnetic Field (IMF), Bt, briefly moderate to start, became weak, around 6 nT. The Bz component varied weakly throughout, ranging between +6/-6 nT. Phi angle was positive (away from the Sun) throughout. Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at background. High energy electron flux (greater than 2MeV) observed by GOES16 was at Background to Moderate with a diurnal peak of 711 pfu at 16/1720 UTC. The associated 24-hour fluence was below the Active threshold. The 17/0000 UTC observation was 1.62e7 total pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity expected with further isolated Moderate flares thought likely, given recent activity and generally increasing magnetic complexity on the disk, with a very slight chance of an isolated X-class flare.

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Solar Wind / Geomagnetic Activity: No Earth directed CMEs feature in the forecast. Ongoing slightly elevated solar winds are expected to gradually ease during day 1 (17 Oct). There is then the potential for elevated winds to develop from late day 1 until day 3 (17-19 Oct), due to a high speed stream from the large coronal hole in the northwest of the disc (CH80/+).

Overall generally Quiet to Unsettled (Kp 2-3) conditions are expected, with Active (Kp 4) intervals likely and a chance of G1/Minor storms (Kp 5) later on day 1 (17 Oct) or into day 2 (18 Oct) due to the potential arrival of a coronal hole high speed stream.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is expected to remain at background, but there remains a slight chance of enhancement toward S1/Minor storm levels. High energy electron flux may rise to high levels days 1 and 2 (17/18) before being further suppressed by likely coronal hole fast winds. The associated 24 hour fluence is expected to rise, but thought most likely to remain below Active (1e8 total pfu).

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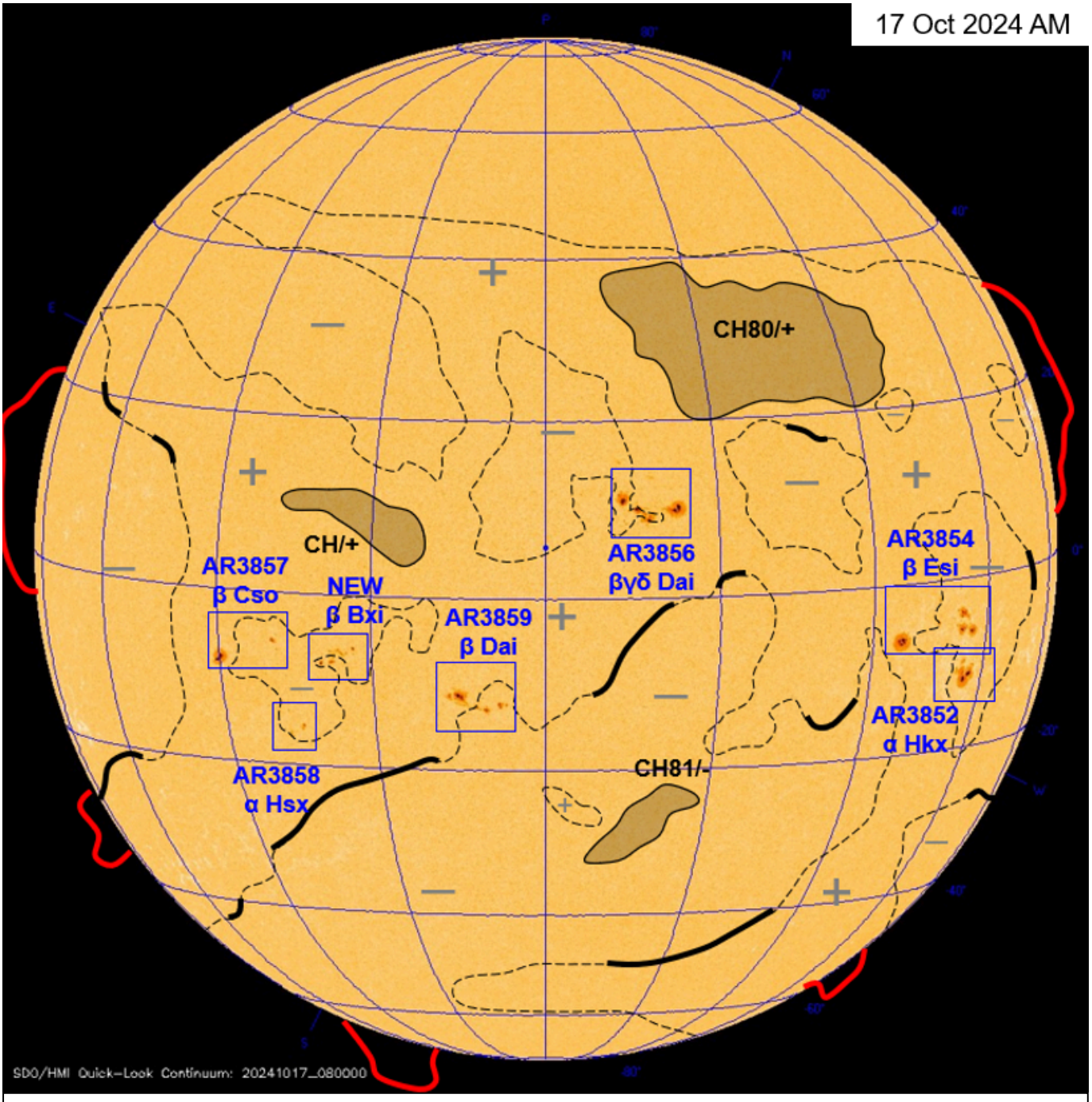
Figure 1: 17/0800 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

No Earth directed CMEs currently feature in the forecast. Ongoing slightly elevated solar winds are expected to continue to gradually ease during day 1 (17 Oct). There is then the potential for elevated winds to develop from late day 1 (17 Oct) into early day 2 (18 Oct), due to an expected high speed stream from the large coronal hole in the northwest of the disc (CH80/+). This feature is significantly larger and more clearly defined than the previous rotation, though the lack of evidence of this coronal hole on the previous solar rotation reduces forecast confidence. Enhancement from this HSS is estimated to present the risk of winds to slightly-elevated or elevated levels of 450-550km/s, with the risk fading into day 3 (19 Oct).

MOSWOC ENLIL output is thought to be giving generally poor guidance, likely due to recent degradation of GONG-H alpha imagery used to calibrate output for the current features on the viable disk.

Overall generally Quiet to Unsettled (Kp 2-3) conditions are expected, with Active (Kp 4) intervals likely and a chance of G1/Minor storms (Kp 5) later on day 1 (17 Oct) or into day 2 (18 Oct) due to the potential arrival of a coronal hole high speed stream.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	30	30	10	10
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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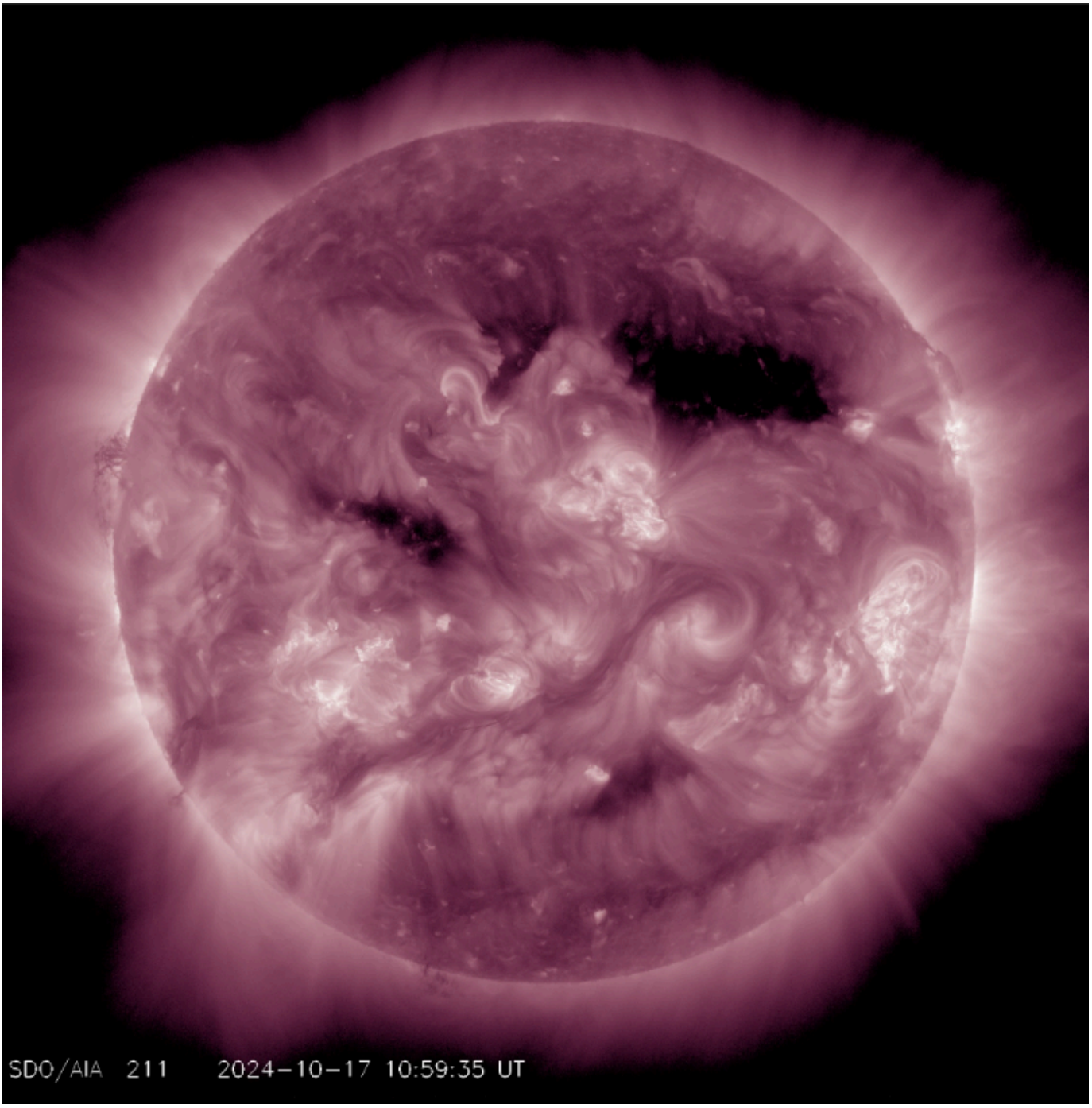
Figure 2: SDO/AIA 211 imagery, with CH80/+ clearly visible in the northwest disk.



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Radio Blackouts - X-Ray Flares

Solar activity has been Moderate, with four R1-class M-flares in the period, the largest an M3.7 at 16/0323 UTC from AR3852.

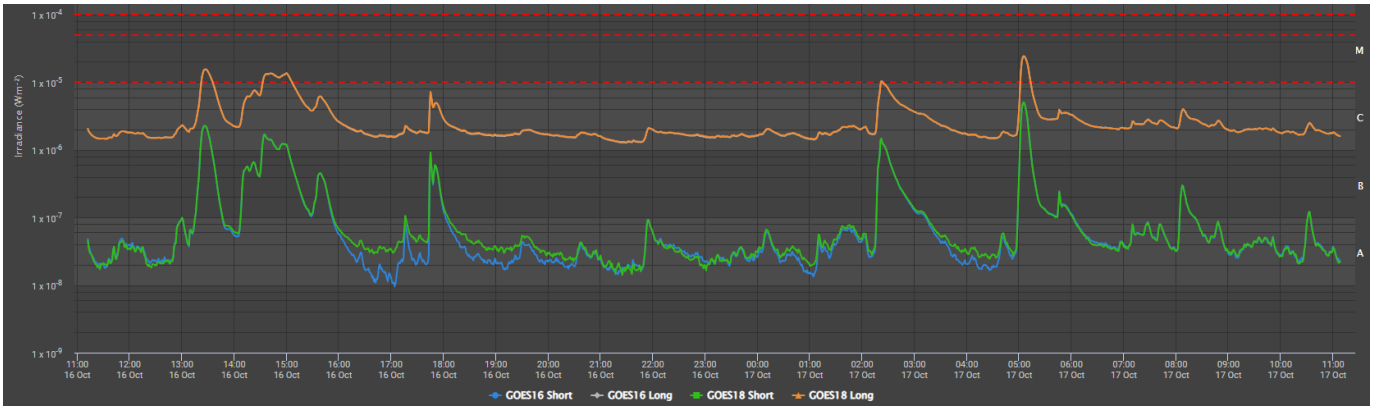
There are currently seven active regions on the visible disc. AR3852 and AR3854 in the southwest quadrant form a coupled pair of sunspots and are the most prominent spot groups on the disc, being responsible for the majority of recent flare activity. Both spot groups will be rotating near the limb by the end of the period but remain on the disk through the forecast period. AR3856 has seen the most notable growth in recent hours, increasing in both size and complexity with an increasingly complex magnetic structure and now likely representing a significant portion of the ongoing flare risk. AR3859 has also displayed growth in recent hours and requires monitoring.

Returning sunspot groups are signaled as a risk by the end of the period via persistence, helping to maintain the current flare risk, pending further developments.

Further isolated Moderate flares are thought likely, given recent activity and generally increasing magnetic complexity on the disk, with a very slight chance of an isolated X-class flare.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	60	60	60	60
Very Active	R3-R5 (X Class)	No	5	5	5	5

Figure 3: Latest 24hr GOES16/18 X-Ray trace.



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Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES18 is expected to remain at background, but there remains a very slight chance of enhancement toward S1/Minor storm levels should any notable flares occur, primarily from any of the larger spots moving across the western hemisphere through the period.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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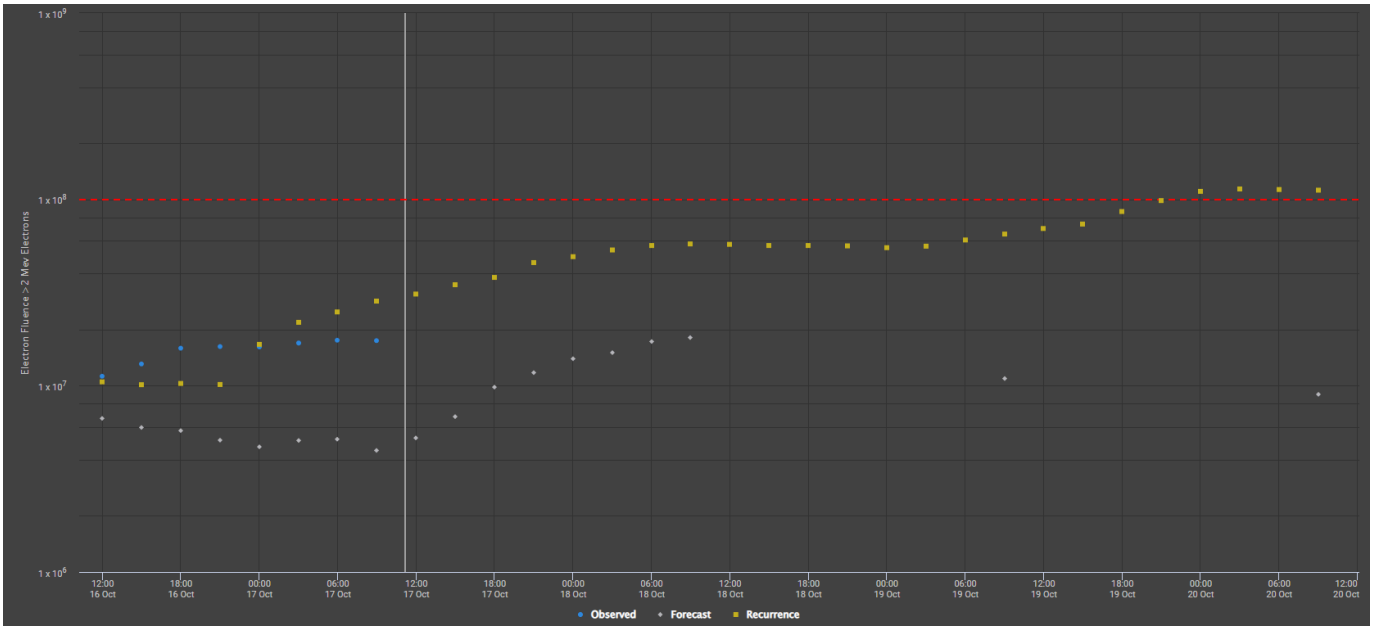
High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES-16 have been at background to moderate levels. As solar winds ease, flux may rise at GEO to become High. However, this is low confidence however with a possible high speed stream onset from later day 1 or day 2 (17/18 Oct). Any such enhancement is likely to suppress flux at GEO to background levels once again.

The associated electron fluence is therefore expected to be below the Active level (1e8 total pfu), but with a possible rising trend into day 2 (18 Oct). MOSWOC REFM model output is viewed as reasonable guidance at present.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	10	15	10	10
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: Latest MOSWOC REFM model output.



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